NASA High End Computing

Systems and Accomplishments

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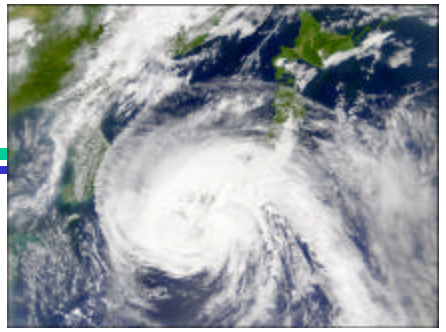
What NASA Excels in …..



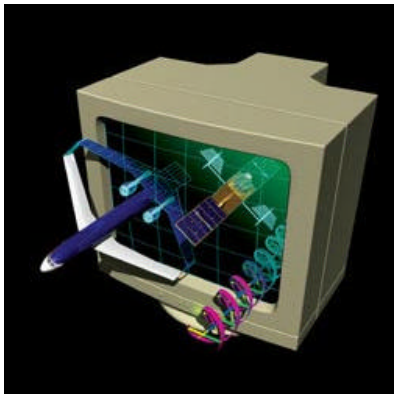
Earth Sciences

- The development of high performance computing methods that allow scientists and engineers to solve real application problems that affect NASA Missions

Space Sciences

Life Sciences

Space Flight

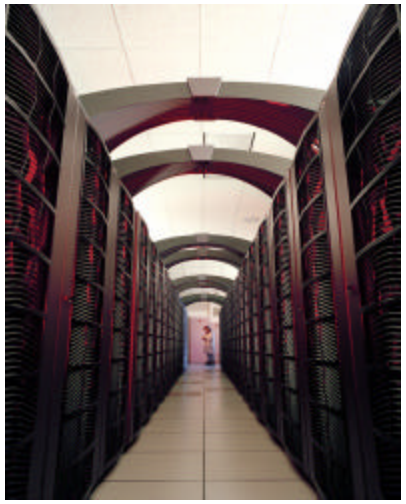


Aerospace Technology

NASA High End Computing Centers

- NASA has focused its most powerful computer capability at Goddard Space Flight Center (GSFC) in Maryland and at Ames Research Center (ARC) in California
- This capability is augmented by mid level systems at other centers

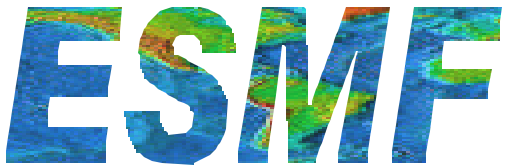
1392p Compaq AlphaServer SC45 at GSFC



1024p SSI Origin 3000 at ARC

512p SSI Origin 3000 at GSFC and at ARC

Earth Science Modeling Framework (ESMF)



Development of software environment to facilitate collaboration and controlled numerical experimentation

ESMF Will Enable Improved Accuracy of Prediction at All Timescales

- –NWP / Tropical Cyclones
- –Seasonal / ENSO Forecasts
- –Interannual and Decadal / Air-sea Gas Exchange Variability
- –Centennial / Climate - IPCC Simulations

ESMF Will Enable New Coupling Scenarios

- –Earth's Surface to Sun's Surface, Combined Geophysics and Societal Dynamics

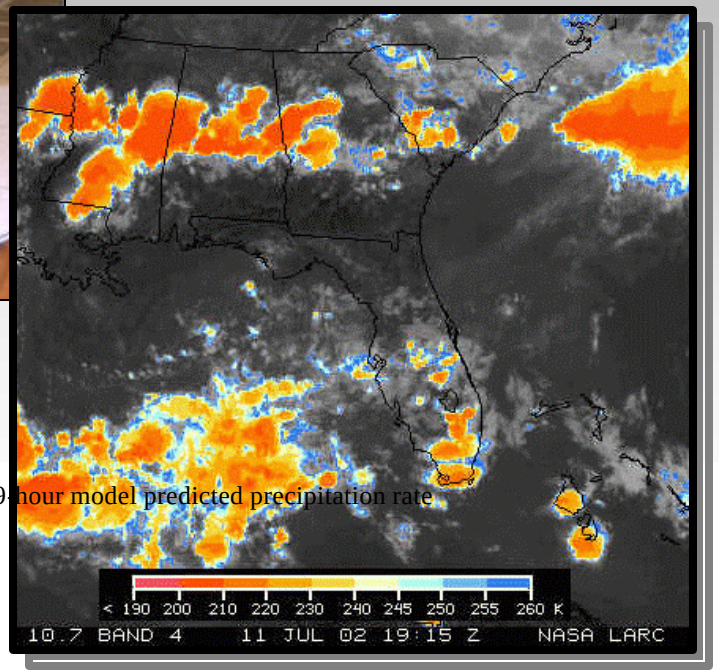
High Performance Computing Resources for Earth Science

Compaq AlphaServer SC45

Primary Supercomputer for the NASA Center for Computational Sciences (NCCS)

880 Processors, 1.25GHz per CPU
512 Processors, 1.0 GHz per CPU
3.2 TeraFLOPS
696 GigaBytes of main memory
8.5 TeraBytes of disk storage

Modeling Earth's Climate:
CRYSTAL-FACE
Cirrus Regional Study of Tropical Anvils
and Cirrus Layers-
Florida Area Cirrus Experiment



19-hour model predicted precipitation rate

Chapman: The First 1024 CPU Origin 3000

ccNUMA

CPUs

- *1024 (MIPS R14000)*
- *600 MHz CPUs*
- *1200 MFLOP/s per CPU*
- *1.2 TFLOPS total*
- *8 MByte cache per CPU*
- *8 GByte total Cache*

Memory

- *256 GB main memory*

Disk

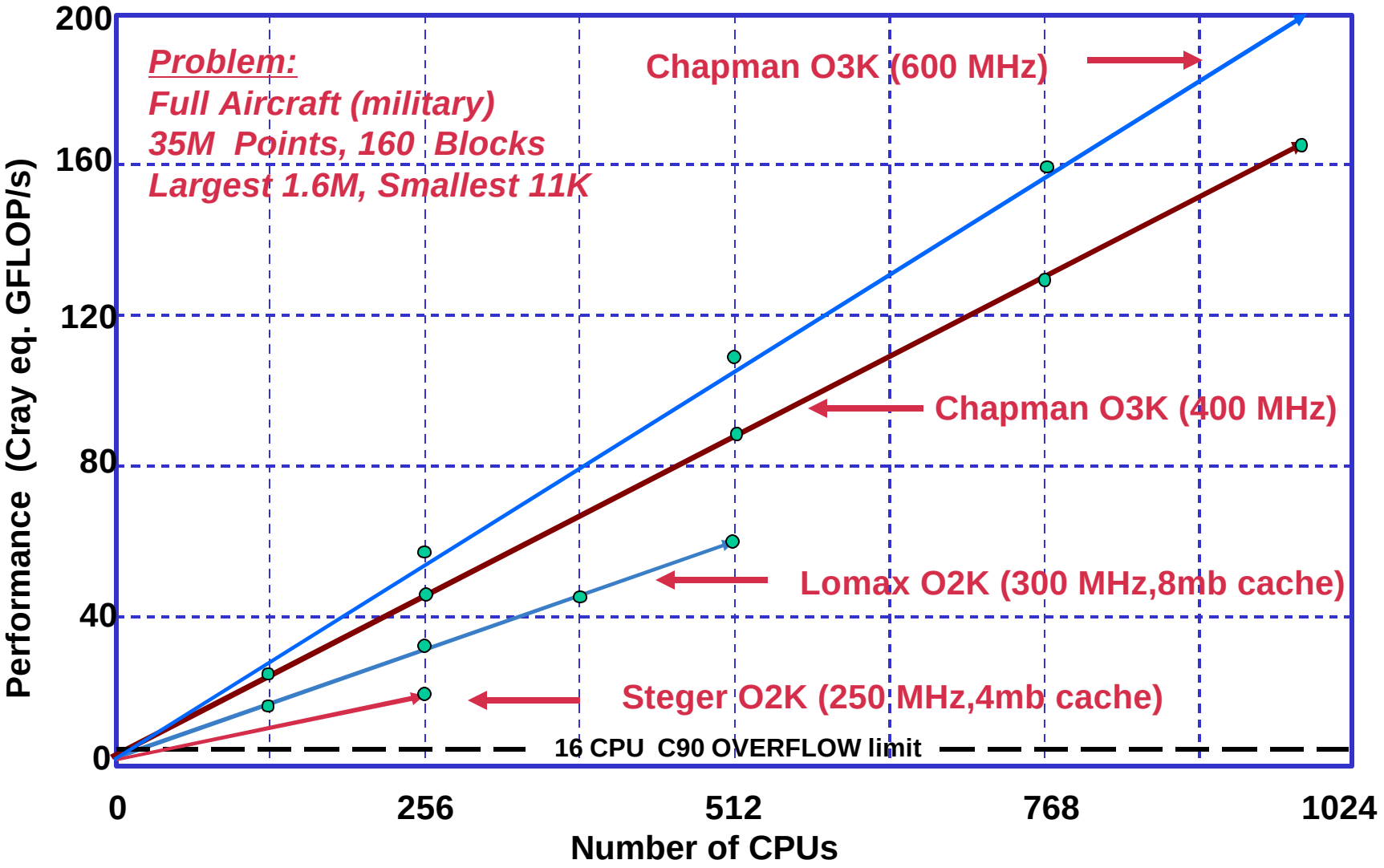
- *10 TB FC Raid disks*

System Software

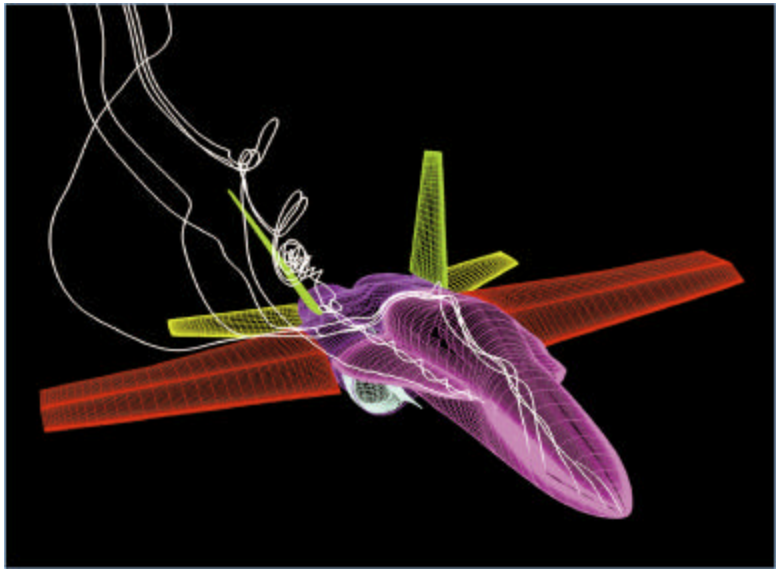
- *OS single system image*
- *Single XFS File System*
- *Compiler parallel 1024 CPUs wide*

OVERFLOW-MLP Performance vs CPU Count

Systems: 1024 CPU O3K , 256&512 CPU O2KS



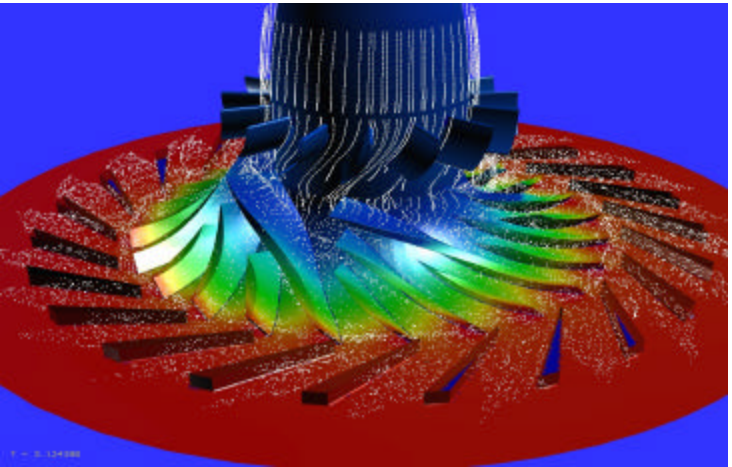
Aircraft Design - Electronic Wind Tunnel Arrives



For the first time, the NAS facility has reached its goal of high fidelity numerical simulation of complex flow about aerospace vehicles and their components.

Last year NAS completed a series of 6 high resolution computations for a full aircraft simulation. The work was completed in a single morning using advanced NAS developed parallelization techniques (MLP). The same work required a full year just four years ago.

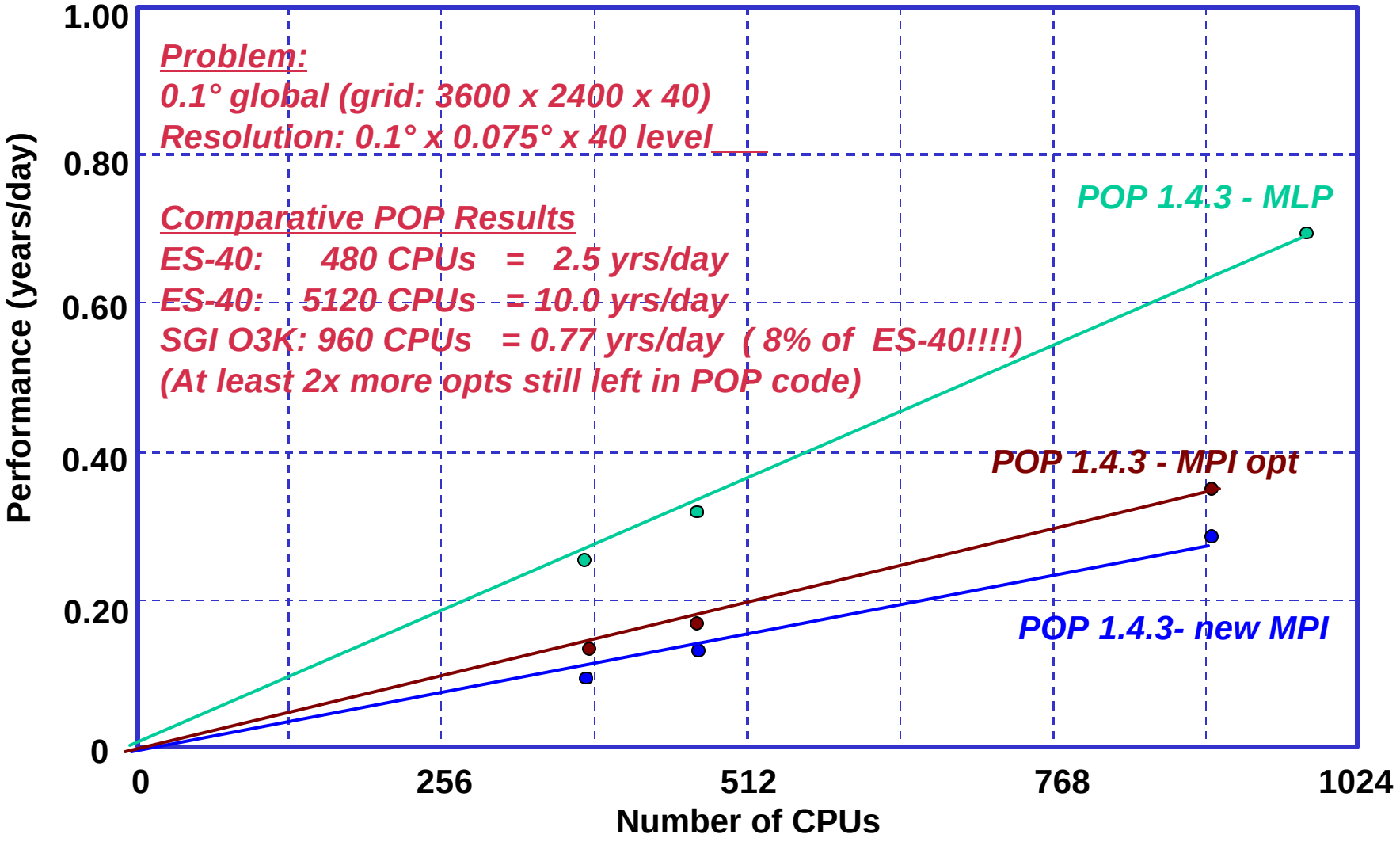
This work has significantly altered the way aircraft design can be done. Boeing has embraced the NASA Ames work, and has requested that NASA pursue converting other code.



During the past year NASA Ames has been working with industry on next gen shuttle turbopump designs. Work at NAS using the MLP version of the ARC developed INS3D CFD code has shortened this design time significantly. Simulations of a particular design required 42 days of computation on the fastest NASA computers just 2 years ago. NAS work shortened this time to 1 day.

POP Performance vs CPU Count (6/12)

System: 1024 CPU O3K 600 MHz (chapman)



CCSM Performance - 1000 year simulation
(4x Better than Best Previous Result!!!!!)

CCSM was recently used by NCAR to complete a 1000 year global simulation using T42 resolution for the atmosphere and 1 degree resolution for the ocean. The simulation required 200 days of compute time to complete on an IBM Power 3 cluster. The code has been partially optimized using MLP The chart below shows the status: